



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF:

GP

(NASA-Case-NPO-11751) COLLAPSIBLE
STRUCTURE FOR AN ANTENNA REFLECTOR
Patent (Jet Propulsion Lab.) 12 p

N73-24176

CSCL 17B

Unclassified
05090

00/07

TO: KSI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U.S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code KSI, the attached NASA-owned U.S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,729,743
Government or
Corporate Employee : CALTECH
Pasadena, CA
Supplementary Corporate
Source (if applicable) : JPL
NASA Patent Case No. : NPO-11751

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes **No**

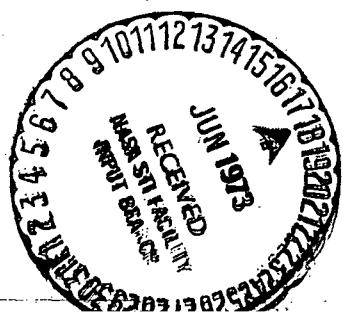
Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of column No. 1 of the Specification, following the words ". . . with respect to an invention of . . ."

Elizabeth J. Carter

Elizabeth A. Carter

Enclosure

Copy of patent cited above



[54] COLLAPSIBLE STRUCTURE FOR AN ANTENNA REFLECTOR

[76] Inventors: James C. Fletcher, Administrator of the National Aeronautics and Space Administration with respect to an invention of; Marc R. Trubert, Covina, Calif.

[22] Filed: Oct. 26, 1971

[21] Appl. No.: 192,141

[52] U.S. Cl.....343/915, 343/DIG. 2

[51] Int. Cl.....H01q 15/20

[58] Field of Search.....343/705, DIG. 2,
343/840, 915

[56] References Cited

UNITED STATES PATENTS

3,631,505 12/1971 Carman et al.343/915
3,617,113 11/1971 Hoyer.....343/915
3,576,566 4/1971 Cover et al.343/915

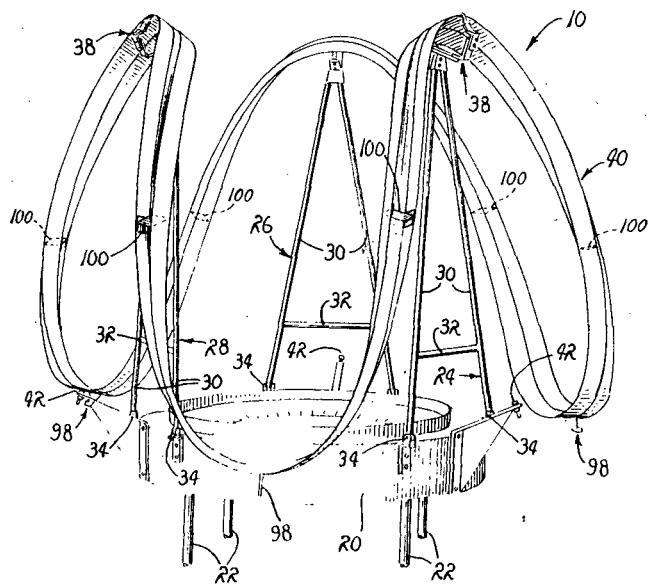
3,618,111 11/1971 Vaughan343/915

Primary Examiner—Eli Lieberman
Attorney—Monte F. Mott et al.

[57] ABSTRACT

A collapsible support for an antenna reflector particularly suited for use in supporting antennas aboard space vehicles and the like. The support is characterized by a rigid base, a plurality of mutually spaced struts pivotally coupled with the base at their base ends, and supported for simultaneous pivotal displacement from a first rest position wherein they are arranged in substantial parallelism to a second rest position wherein they are arranged in a substantially diverging relationship, and an endless band, coupled with the distal ends of the struts, fabricated to be supported in a flexible, serpentine configuration when the struts are in said first rest position and in a rigid annular configuration when said struts are in said second rest position.

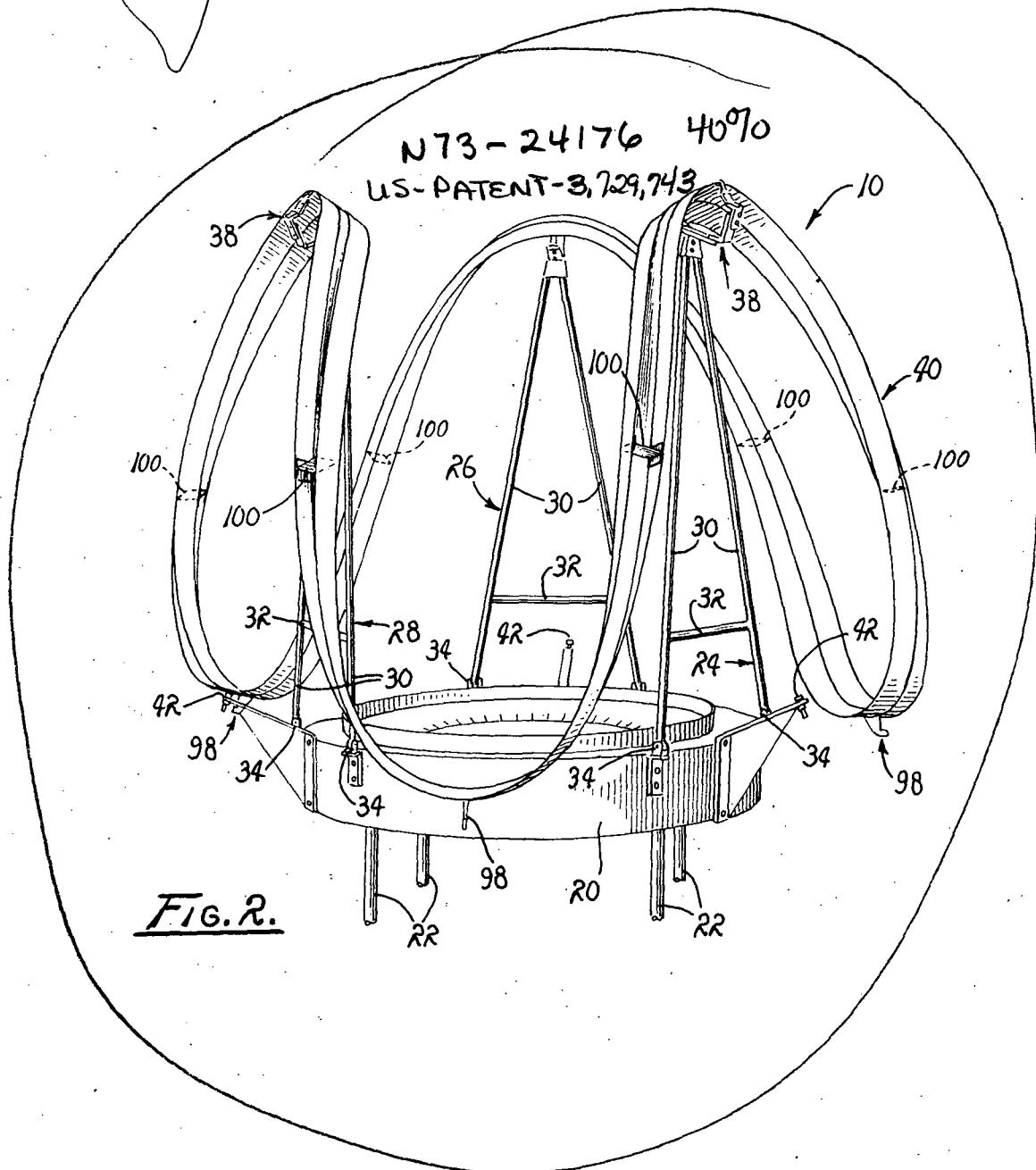
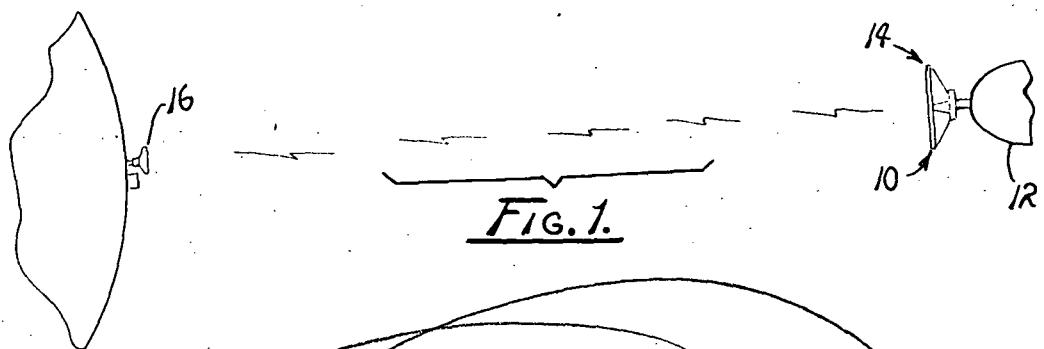
20 Claims, 16 Drawing Figures



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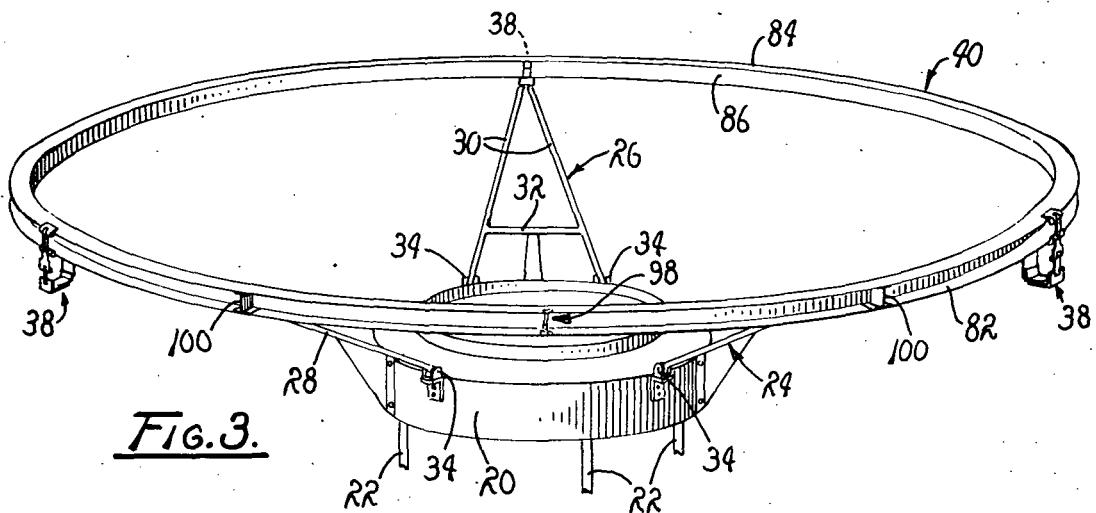


FIG. 3.

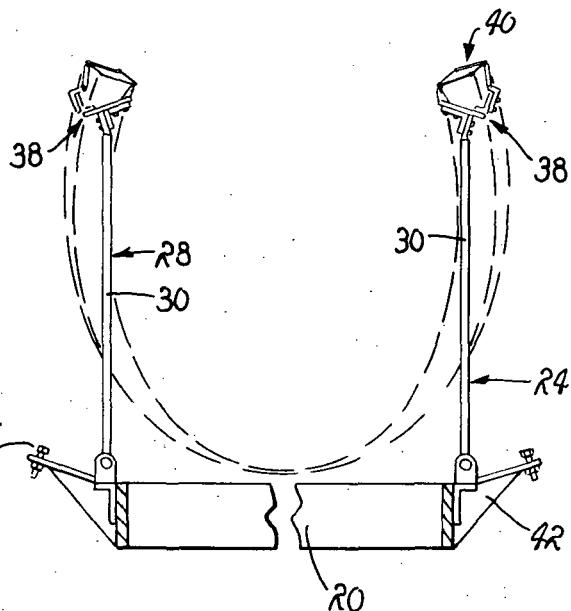


FIG. 4.

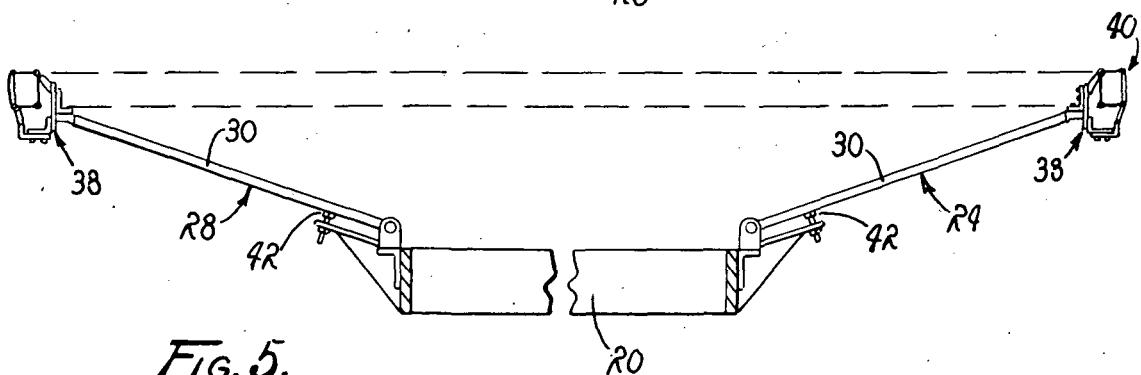
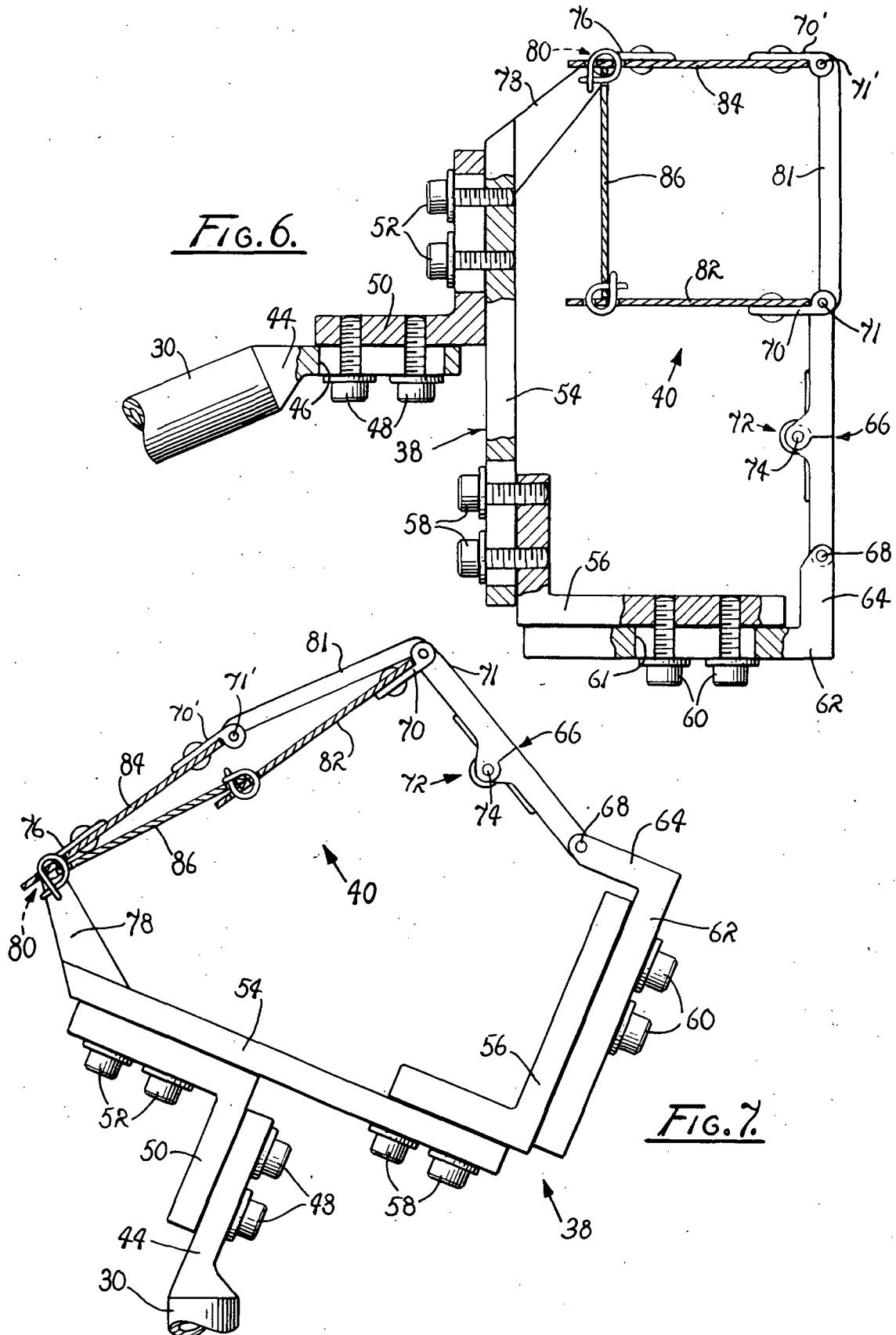


FIG. 5.

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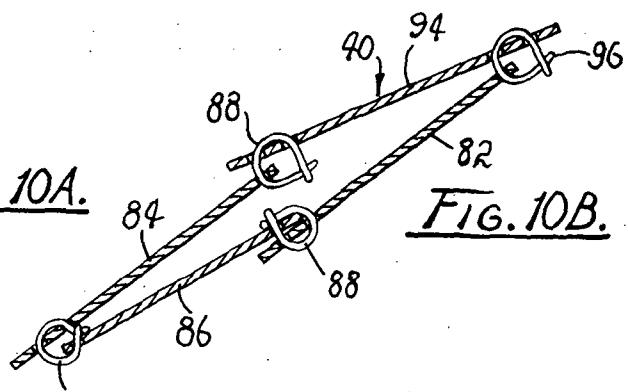
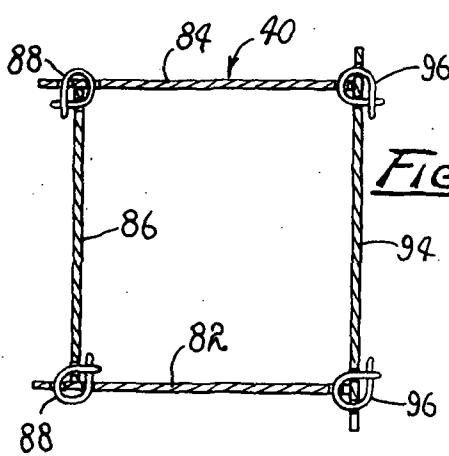
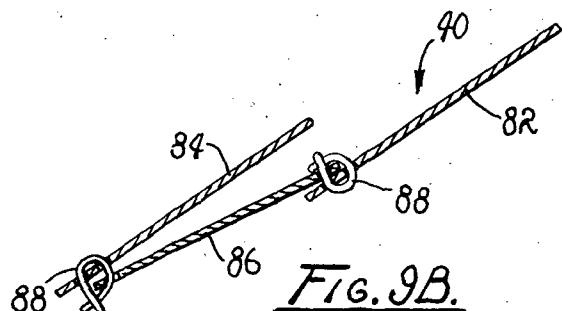
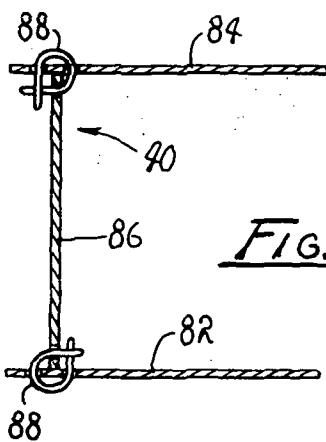
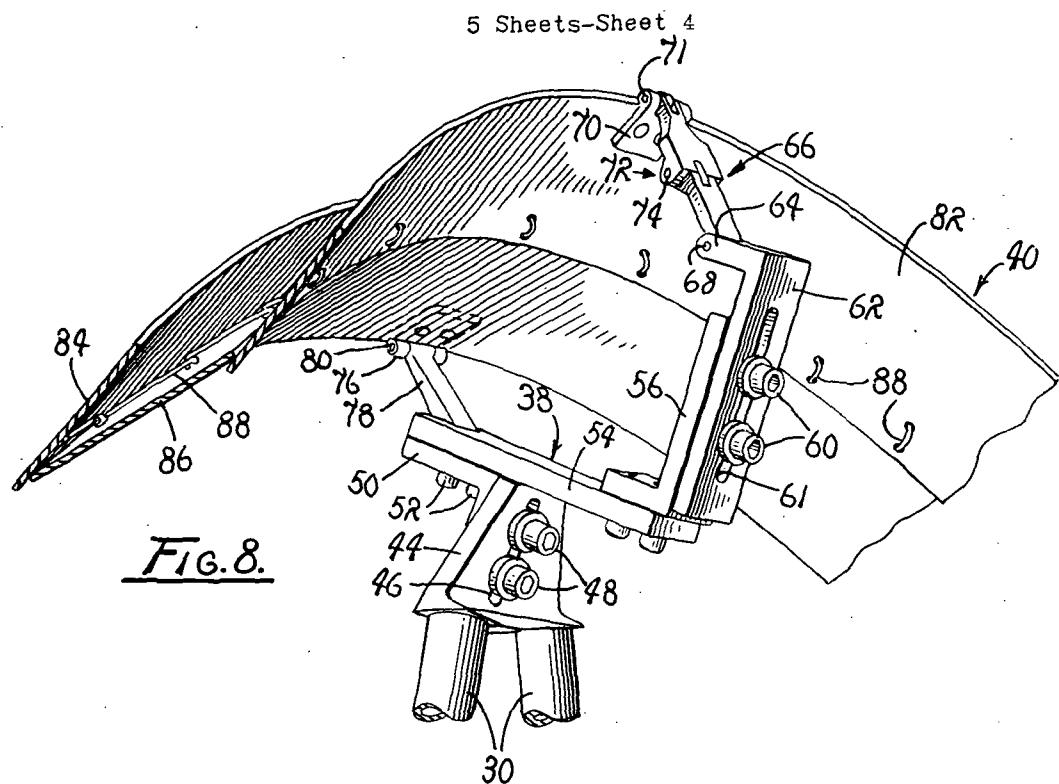
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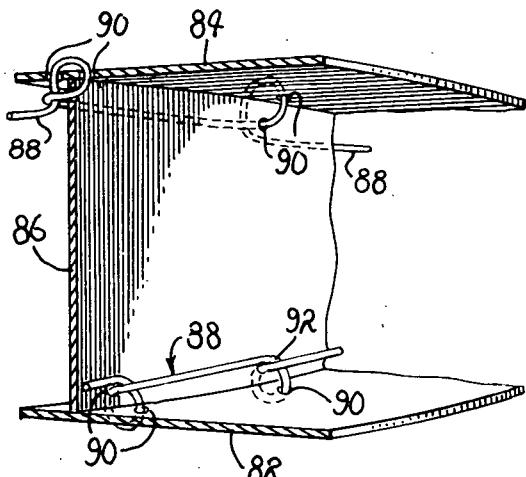


FIG. 11.

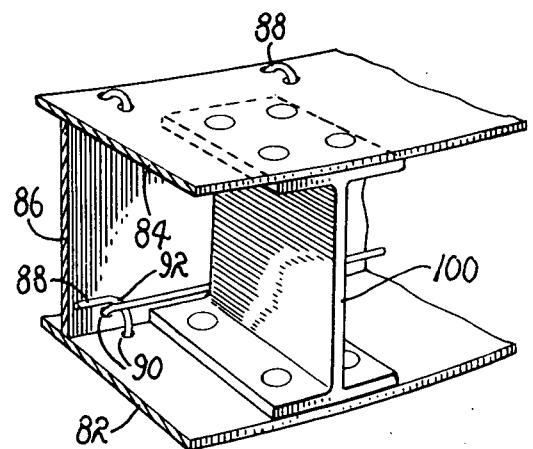


FIG. 12.

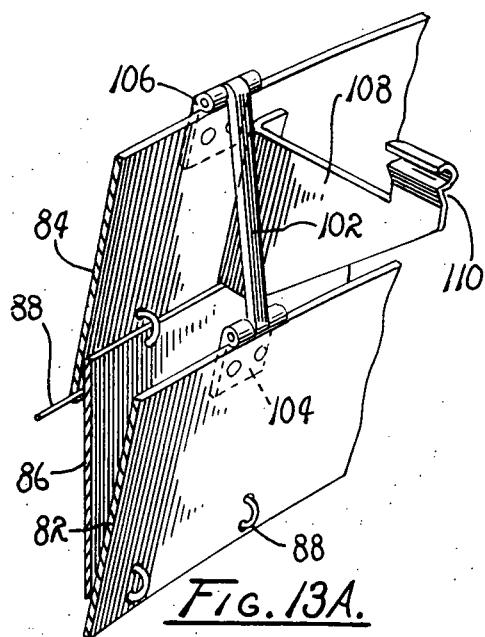


FIG. 13A.

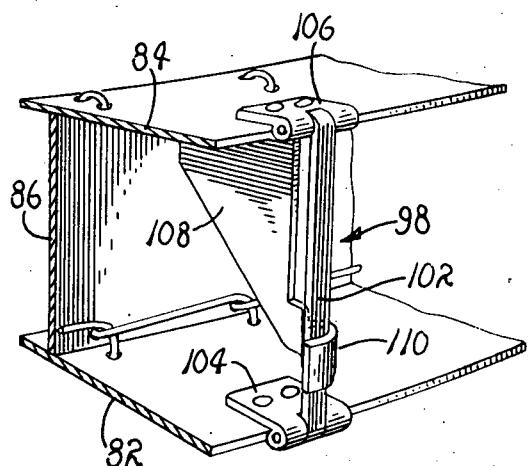


FIG. 13B.

COLLAPSIBLE STRUCTURE FOR AN ANTENNA REFLECTOR

ORIGIN OF INVENTION

The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to collapsible supports and more particularly to a collapsible support particularly suited for supporting a furlable antenna reflector dish aboard an operative space vehicle.

2. Description of the Prior Art

In missions of extended duration wherein space vehicles are sent to planets in celestial space, it is desirable that data obtained by on-board systems be transmitted to the planet earth utilizing minimal power. Normally, transmission occurs at or shortly after the time of rendezvous or encounter with selected planets, thus requiring transmission of data over great distances. Due to the extremely long communication links encountered in the transmission of data from deep space, systems employing so called high-gain antennas normally are relied upon in establishing and maintaining required communication between the vehicles and earth stations. Of course, high-gain antennas are characterized by their large diameter and accordingly present stowage problems during take-off and prior to insertion of an equipped space vehicle into a selected trajectory. Due to the limitations currently imposed on bulk, difficulty in packaging is encountered when antennas having excessively large diameters are proposed for use aboard space vehicles, due to a practical lack of available space.

Various attempts have been made to overcome this difficulty including a use of furlable antenna reflectors of various configurations. Unfortunately, the existing structures currently available have failed to fully satisfy the needs of those engaged in designing and packing telemetry systems for use in deep-space communication systems.

OBJECTS AND ADVANTAGES OF THE INVENTION

It is therefore an object of the instant invention to provide an improved collapsible support.

It is another object to provide an improved collapsible support particularly suited for use in supporting dish reflectors for antennas.

It is another object to provide an improved collapsible support for use in supporting antenna reflectors aboard operative space vehicles.

It is another object to provide a collapsible support characterized by its capability of being collapsed into a compact configuration for storage aboard a space vehicle and subsequently deployed into a relatively rigid and enlarged configuration.

It is another object to provide an improved collapsible support which utilizes a plurality of mutually spaced struts pivotally supported at their base ends and coupled at their distal ends to an endless flexible band so

configured as to be collapsed into a compact configuration and subsequently expanded into a rigid, annular configuration for supporting an antenna dish employed in a deep-space communication system.

5 These and other objects and advantages of the instant invention are achieved through the use of a collapsible support which includes a base, an array of struts, spaced at equidistances, pivotally coupled with the base and supported for pivotal displacement from a first rest position, wherein the struts are arranged in substantial parallelism, to a second rest position wherein the struts are arranged in a substantially diverging relationship, and an endless flexible band 10 coupled with the struts at their distal ends adapted to assume a serpentine configuration when the struts are in the first rest position and subsequently assume a rigid annular configuration when the struts are in their 15 second rest position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a pictorial view depicting the support of the instant invention aboard a space vehicle in a celestial space environment.

FIG. 2 is a perspective view of the collapsible support, which includes a plurality of struts coupled, through brackets, with a flexible band, in its collapsed, compact configuration, as assumed by the support preparatory to launch aboard a space vehicle.

FIG. 3 is a perspective view of the collapsible support shown in FIG. 1, in its fully expanded, operative configuration.

FIG. 4 is a partially sectioned side elevation of the support illustrating a first rest position for the plurality of supporting struts when the support is configured as illustrated in FIG. 2.

FIG. 5 is a partially sectioned side elevation illustrating a second rest position assumed by the struts when the support is configured as illustrated in FIG. 3.

FIG. 6 is a partially sectioned, enlarged view of a bracket, employed in coupling the flexible band with the distal end of each of the struts, illustrating the cross-sectional configuration of the flexible band when the support is in its operative configuration.

FIG. 7 is another view of the bracket shown in FIG. 6, illustrating the cross-sectional configuration of the flexible band when the struts are in their first rest position, as illustrated in FIG. 2.

FIG. 8 is a perspective view of the bracket shown in FIGS. 6 and 7, also illustrating the configuration assumed by the flexible band when the struts are in their first rest position.

55 FIGS. 9a and 9b are cross-sectional views illustrating alternate configurations assumed by the flexible band as the struts are supported in their alternate rest positions.

FIGS. 10a and 10b collectively depict alternate configurations assumed by a modified form of the flexible band shown in FIGS. 2 and 3.

FIG. 11 is a fragmentary view of the flexible band in its expanded configuration, depicting stitching employed in fastening the components of the band.

65 FIG. 12 is a fragmentary view of the band shown in FIGS. 2 and 3, illustrating a gusset employed in imparting rigidity to the band.

FIGS. 13a and 13b collectively illustrate alternate positions for a latch employed in supporting components of the band in an expanded, substantially rigid configuration.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings herein like reference characters designate like or corresponding parts throughout the several views, there is pictorially depicted, on an exaggerated scale, an operative environment for the collapsible support which embodies the principles of the instant invention.

As shown in FIG. 1, the collapsible support, designated 10, is mounted aboard a space vehicle 12 and is employed in supporting a flexible membrane, not shown, employed as a reflector dish for an antenna 14 mounted aboard a space vehicle and directed toward a station 16 located on the planet earth. Since the flexible membrane, space vehicle 12, antenna 14 and earth station 16 form no specific part of the instant invention, a detailed description thereof is omitted in the interest of brevity. It is, however, to be understood that the support 10 is particularly suited for use in supporting the peripheral portions of a membrane of a concave configuration, formed of aluminized Mylar, for example. The support, of course, supports the membrane in its compact configuration, assumed preparatory to its being launched aboard a space vehicle, and its expanded operative configuration, as shown in FIG. 3.

The support 10 includes a base 20 fabricated from a suitable material and united with the space vehicle 12 through suitable struts 22. The construction of the base 20, and the mounting thereof, is believed to be well within the purview of the art and therefore a detailed description thereof is omitted.

As illustrated, the base 20 is of a cylindrical configuration, however, it should readily be apparent that the particular configuration of the base 20 is a matter of convenience and can be varied as dictated by the nature of the vehicle and its mission.

Pivots coupled to the base 20, at spacings of 120°, there are three struts 24, 26 and 28. Each of these struts is formed as an A-frame and includes a pair of mutually inclined beams 30 laterally spaced at their base ends and united at their distal ends. A transverse brace 32 is extended between the beams of each pair of beams for imparting rigidity thereto.

The base ends of the beams are coupled with the base 20 through suitable pivot couplings 34. These couplings accommodate a pivotal rotation of the struts in planes normal to the longitudinal axis of symmetry of the support 10. Since the particular pivot couplings employed can be varied as desired, a detailed description thereof is omitted. However, it is to be understood that the couplings 34 serve to pivotally couple the beams 30 of each of the struts 24, 26 and 28 with the base 20 in a manner which accommodates pivotal displacement of the struts from a first rest position wherein the struts assume a substantially parallel relationship, as best illustrated in FIG. 2, to a second rest position, as best illustrated in FIG. 3, wherein the struts assume a substantially diverging relationship as the support is supported in its expanded and rigid configuration.

As best shown in FIGS. 6, 7 and 8, the distal end of each of the struts 24 through 28 is provided with a bracket 38 which couples each of the struts with an endless flexible band 40. The band 40, when the struts 24 through 28 are disposed at their first rest position, is supported by the brackets 38 in a substantially serpentine configuration, as best shown in FIG. 2, while it is caused to assume a substantially rigid annular configuration, as shown in FIG. 3, when the struts 24 through 28 are disposed at their second rest position.

Accordingly, it is to be understood that preparatory to launching the associated space vehicle 12, the support 10, including the struts 24 through 28 and the band 40, is collapsed into a compact configuration and encased within a suitable shroud.

Similarly, it is to be understood that once the space vehicle has been injected into a selected trajectory the support 10 is expanded into a fully operative, rigid configuration upon receipt of a command signal delivered thereto from a control station 16.

The mechanism employed in displacing the struts 24 through 28 for expanding the support 10 is varied as is found desirable for selected missions. Such structure includes worm gears, springs, hydraulic actuators, and similar mechanisms well within the purview of the art. Since the particular mechanism employed in erecting the support forms no specific part of the instant invention, a detailed description thereof is omitted in the interest of brevity. However, it is to be understood that the mechanism employed is compatible with the space vehicle and its mission, and is employed in pivotally displacing the struts 24 through 28 from their first rest position, wherein they are arranged in substantial parallelism, to their alternate or second rest position, wherein the struts are arranged in a substantially diverging relationship, as best illustrated in FIGS. 3 and 5. In practice, a plurality of stops 42 are provided for supporting the struts 24 through 28 and their diverging relationship. While the stops 42 are shown as brackets, other types of stops can be employed equally as well.

The brackets 38 employed in coupling the struts 24 through 28 with the band 40 are of a similar design and serve a similar purpose. Therefore, a description of a single bracket 38 will serve to provide a complete understanding of the invention. As best illustrated in FIGS. 6 through 8, the beams 30, forming one of the struts 24, 26 and 28, terminate in a terminal plate 44 coupled therewith, as by welding or the like, FIG. 8. The terminal plate 44 is provided with an elongated slot-like opening 46 for receiving therein a pair of studs 48. The studs 48, in turn, are used in coupling with each of the struts 24 through 28 a right angle terminal bracket 50. The terminal bracket 50 also includes a slot-like opening, not designated, which receives a pair of mounting studs 52 employed in mounting thereon a base plate 54 for the bracket 38. Upon the base plate 54 there is adjustably mounted a bracket 56, coupled thereto through a plurality of studs 58 seated in a slot-like opening, not designated.

From the adjustably mounted bracket 56 there is extended a pair of studs 60 seated in a slotted opening 61, formed in a shoulder bracket 62. The shoulder bracket 62 includes an arm 64 extended in substantial parallelism with the base plate 54 and serves as a base to which at one end of the toggle arm 66 is pivotally united

through a suitable pivot pin 68. The opposite end of the toggle arm 66 is provided with a hinge plate 70 pivotally coupled to the toggle arm by a pivot pin 71, and riveted, spot-welded or otherwise securely fixed to the band 40. Since the particular manner in which the hinge plate 70 is coupled with the band 40 is deemed to be a matter of convenience, a detailed description is omitted. However, it is to be understood that a rigid coupling is provided for between the hinge plate 70 and the band 40. A link 81 is provided for connecting the planar support members 82 and 84 at the pivot 71 and through an additional pivot 71', established by a plate 70' fixed to the member 84.

Within the toggle arm 66 there is included a toggle joint 72, formed by a suitable pivot including a pivot pin 74. In practice, the toggle joint 72 is employed to accommodate both a compaction and an erection of the band 40, all in a manner which will hereinafter be more clearly set forth.

In addition to being coupled with the bracket 38 at the hinge plate 70, the band 40 is further coupled with the bracket at a hinge plate 76. Like the hinge plate 70, the hinge plate 76 is riveted, welded or otherwise coupled with the band 40, so long as a rigid coupling therebetween is achieved. The hinge plate 76 is pinned to the distal end of a cantilevered bracket arm 78 through a suitable pivot pin 80. In practice, the arm 78 is extended radially with respect to the support 10 and is rigidly fixed to the base plate 54. In practice, the band 40 includes a pair of planar support members 82 and 84 of annular configurations and of similar dimensions. The support members 82 and 84 are axially spaced a distance determined by the length of an interposed web 86 of a cylindrical configuration. The cylindrically configured web 86 and the support members 82 and 84 are united by being stitched together with a relatively fine, flexible length of wire 88 passed through appropriately formed openings 90 and configured into an overhand running stitch. Each stitch therefore includes a terminal portion 90 configured as a ring 92 which serves to unite the cylindrical web with one of the support members in a pivotal manner. Hence, it should readily be apparent that pivotal displacement of the support members 82 and 84, relative to the cylindrical web 86 readily is accommodated. Accordingly, as alternately illustrated in FIGS. 9a and 9b, selected portions of the band 40 can be supported in an expanded, laterally opening U-shaped configuration and, alternatively, supported in a collapsed, substantially planar configuration. Preferably, the support members 82 and 84, as well as the web 86, are fabricated from a flexible metallic material such as aluminum.

As illustrated in FIGS. 10a and 10b an additional flexible cylindrical web 94 is, where so desired, utilized in a spaced concentric relationship with the web 86. This web is quite similar to the web 86 in design and function and is united with the peripheral portions of the support members 82 and 84, by stitching the adjacent members together employing a second wire 96, and in a manner similar to that in which the wire 88 is used in stitching the cylindrical web 86 to the support members 82 and 84. Thus, it is possible to impart a rectangular configuration to the band 40 for thus enhancing the total rigidity of the band 40 when the struts 24, 26 and 28 are in their diverging, second rest position, as illustrated in FIG. 3.

It will, of course, be appreciated that when the support 10 is collapsed into a compact configuration wherein the struts 24 through 28 are disposed in substantial parallelism, the band 40 necessarily is collapsed at each of the brackets 38 so that a line extending through the planes of the annular support members 82 and 84 defines included angles with respect to a line extended from the pin 80 and paralleling the longitudinal axis of symmetry of the cylindrical web 86, at each of 10 the brackets 38, so that the band 40 is permitted to assume the serpentine configuration illustrated in FIG. 2.

Of course, when the struts 24 through 28 are pivotally displaced to their second rest position, about their pivotal couplings 34 to assume a mutually diverging relationship, the planar support members 82 and 84 are mutually pivoted with respect to the cylindrical web 86, about the stitching formed by the wire 88. Simultaneously therewith, the toggle arm 66 is rotated about the pivot pin 68 for thus permitting the support members 82 and 84 to be brought into an axially spaced coplanar relationship. Due to the pivoting of the support members 82 and 84 relative to the web 86, little difficulty is encountered in rotating the toggle arm 66 into parallel relationship with the base plate 54. In this position, a vertical support is imparted to the band 40 at the hinge plate 70. As can readily be appreciated, in order to either erect or collapse the band 40, rotation of the cylindrical web 86 and the support member 82 20 along an arc having a radius extended to the pivot pin 80 must be accommodated. This, of course, requires that the toggle arm 66 be rotated about the pivot pin 68. However, in order to accommodate rotation of the toggle arm 66, momentarily, it is broken at the toggle joint 72 as the periphery of the member 82 approaches an imaginary line extended between the pivot pins 71 and 80, due to the fact that the combined effective dimensions of the support member 82 and web 86 exceed the total length of the imaginary line.

Accordingly, it is to be understood that the toggle arm 66, for each of the brackets 38, imparts vertical support to the outer periphery of the band 40 so long as the band is in its expanded and erected configuration. Upon being broken at the toggle joint 72, the toggle arm 66 permits a displacement of the outer periphery of the support member 82 for thus enhancing the erecting and collapsing of the band 40.

Like the band 40 of the outwardly directed U-shaped cross-sectional configuration, the band having the aforementioned rectangular cross-sectional configuration also can be collapsed simply by breaking the toggle arm 66 at the toggle joint 72 due to the pivotal coupling of the web 94 with the support members 82 and 84 by the stitches formed by the wire 96.

In order to enhance rigidity of the band 40 a plurality of latches 98 are provided midway between each pair of the struts 24 through 28. These latches, when disengaged, permit the support members 82 and 84 to be rotated relative to the web 86, but, when engaged, serve to impart rigidity to the band 40 by fixing its cross-sectional configuration, as will hereinafter be more fully discussed.

The band 40 is further provided with a plurality of fixed gusset plates 100, each being located between a latch 98 and one of the brackets 38.

The gusset plates 100 are of a rigid configuration and extend between the support members 82 and 84. Any

suitable means, including riveting, spot-welding and the like are employed in securing the gussets to the support members.

In practice, the band 40 is provided with six gusset plates 100, while only three latches 98 are employed. By so arranging the latches 98 and the gusset plates 100, the cross-sectional configuration of the band 40 is fixed at points requiring minimal deflection while maximum deformation is accommodated at points requiring maximum deflection of the band 40, in order to permit the band to assume a fully collapsed, serpentine configuration. Furthermore, by employing the gusset plates 100 at points between the latches 98 and the brackets 38, memory is imparted to the band 40, upon its being erected to a fully expanded configuration.

Each of the latches 98 includes a latching bar 102 pivotally coupled with the peripheral portions of the support members 82 and 84 of the band 40.

In order to impart maximum rigidity to the band 40, in its expanded configuration, each of the latching bars 102 is coupled with the annular support members 82 and 84, by a pair of hinge plates 104 and a pair of hinge pins 106. Each of the bars 102 is secured in a vertical relationship with respect to the plane of the support members 82 and 84 by a resilient gusset plate 108 rigidly fixed to the annular support 84, by rivets, spot-welds and the like, not designated.

The resilient gusset plates 108 are so configured as to include locking detents 110 which receive therein the latching bars 102 for thus securing the latching bars in a fixed relationship with respect to the support member 84. As a practical matter, the locking detents 110 are so configured that the latching bars 102 are fixed in a plane vertically related to the support members 82 and 84 and, consequently, impart rigidity to the band 40 when it is fully expanded. In order to assure that a locking engagement is achieved between the latching bars 102 and the resilient gusset plates 108, the gusset plates are formed of an inherently resilient material and are so mounted adjacent the latching bars 102 that the plates are spring-biased toward the latching bars. In practice, the inherent resiliency of the material is utilized for maintaining the gusset plates 108 in engagement with the latching bars 102 so that as the support members 82 and 84 are deployed in parallel planes, the locking detents 110 receive the latching bars 102 in a "snapping" fashion whereupon a rigid coupling is achieved therebetween and the latching bar 102 is maintained at a plane normal to the planes of the support members 82 and 84 for supporting the peripheral portions of the support members.

The collapsible support 10, assembled and erected, is collapsed simply by releasing the toggle joint 72 and the various latches 98, which, of course, can be manually effected and thereafter displacing the struts 24 through 28 from their aforementioned second rest position, to their aforementioned first rest position, wherein they are disposed in a mutually parallel relationship so that the band 40 is caused to assume its serpentine configuration. Similarly, the support 10 is erected by releasing the toggle joint 72 and thereafter displacing the struts 24 through 28 to their second rest position. Of course, as the band is expanded it is caused to assume a planar annular configuration, at which time the latching bars 102 are engaged by the locking de-

tents 110 which fix the relationship of the latching bars with respect to the support members 82 and 84 for imparting rigidity to the band 40.

OPERATION

It is believed that in view of the foregoing description, the operation of the device will be readily understood and it will be briefly reviewed at this point.

Preparatory to launching, the band 40 is collapsed into its serpentine configuration, as the struts 24 through 28 are advanced into a substantially parallel configuration as best illustrated in FIGS. 2 and 4. It will, of course, be appreciated that to the band 40 there is affixed a reflector membrane as afore discussed, which has the desired electrical reflective characteristics and which is capable of being furled for storage and unfurled as the resulting antenna reflector is erected. Once the band 40 has been collapsed into a compact configuration, as illustrated in FIG. 2, the collapsible support 10 is inserted into a shroud located aboard a space vehicle.

Once the space vehicle has been injected into a selective trajectory, a command signal is transmitted from the ground station 16 to the vehicle, whereupon the shroud is caused to disassociate itself from the collapsible support 10. An additional command signal preferably is employed for causing the struts 24 through 28 to be rotated about their pivotal couplings into a diverging relationship wherein the band 40 is caused to assume a rigid, coplanar configuration.

As the struts 24 through 28 are displaced from their first rest position, wherein they are arranged in a substantially parallel relationship, to their second rest position, wherein they are disposed in mutually diverging relationship, the toggle bar 66 is broken, if so required, at the toggle joint 72 by the resultant forces sufficiently for permitting the support member 82 to rotate relative to the cylindrical web 86, at the stitching formed by the wire 88. During the displacement of the struts, the resilient gusset plates 108 are caused to slidably advance along the surface of the latching bars 102 until such time as the latching bars 102 enter the locking detents 110, whereupon the latching bars 102 are secured in a normal relationship with respect to the planes of the support members 82 and 84 so that the band 40 is caused to assume a rigid, planar configuration. In view of the fact that the band 40 having a U-shaped cross-sectional configuration is fixed at 12 points about its periphery, rotation of the support members 82 and 84 relative to the cylindrical web 86 is precluded so that deformation of the band 40 is avoided under normal operative conditions.

In instances where a band 40 of a rectangular cross-sectional configuration is employed, as a consequence of the inclusion of the web 94, the links 81 and the latching bars 102 are eliminated, as their functions are no longer desirable. However, it is important to note that in such instances, the web 94 is formed to include appropriately formed openings, not shown, through which the gusset plates 108 are afforded passage as pivotal displacement of the support members 82 and 84 occurs, relative to the webs 86 and 94. Furthermore, the detents 110 serve to receive edge portions of the web 94 for achieving therebetween a latching function so that the web 94 is supported by the gusset plates 108.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the illustrative details disclosed.

What is claimed is:

1. A collapsible support comprising:

- A. a base for said support;
- B. a plurality of mutually spaced struts pivotally coupled at their base ends with said base and supported for simultaneous pivotal displacement from a first rest position, wherein the struts are arranged in a substantially parallel relationship, to a second rest position, wherein the struts are arranged in a substantially diverging relationship; and
- C. an endless flexible band coupled with the distal ends of said plurality of struts, including a web of a substantially cylindrical configuration supported in coaxial relationship with said base and a pair of axially spaced support members of an annular configuration integrally related with said web and radially extended therefrom when said struts are in said second rest position.

2. The support of claim 1 wherein said flexible band is supported in a serpentine configuration when said plurality of struts are in said first rest position and in a planar configuration when said struts are in said second rest position.

3. The support of claim 2 wherein said endless flexible band assumes a collapsible U-shaped cross-sectional configuration when said struts are in said second rest position.

4. The support of claim 2 wherein said band includes:

- A. a web of a substantially cylindrical configuration; and
- B. a pair of axially spaced planar members of an annular configuration coaxially related to said web and arranged in a coplanar relationship, each being united with an annular end portion of said web, whereby said flexible band is caused to assume a radially directed, substantially U-shaped cross-sectional configuration when said struts are in said second rest position.

5. The support of claim 4 wherein the surfaces of selected adjacent portions of said web and said planar members define acute angles with respect to a common line when said struts are in said first rest position.

6. The support of claim 5 wherein said planar members are pivotally coupled with said web and further includes a plurality of rigid gussets extended between said planar members and rigidly fixed thereto.

7. The support of claim 6 further comprising means including a plurality of releasable latches mounted on said band in mutually spaced relationship for releasably uniting axially spaced peripheral portions of said pair of planar members in a fixed relationship when said struts are in said second rest position.

8. The support of claim 7 wherein each of said latches includes:

- A. a latching bar pivotally coupled at its opposite ends to axially spaced peripheral portions of said planar members;
- B. a resilient gusset plate rigidly fixed to one of said planar members, biased into frictional engagement with said bar; and

C. means defining a locking detent for said resilient gusset plate having an opening disposed in a plane adjacent to said bar for releasably receiving therein the bar when said struts are in said second rest position.

9. The support of claim 8 wherein said flexible band is coupled with the distal ends of said plurality of struts by means including a plurality of brackets, each of said brackets comprising means including a toggle linkage for supporting said band at diagonally related peripheral portions of said band.

10. The support of claim 4 further including means for pivotally uniting the planar members with said web.

11. The support of claim 10 wherein said means for pivotally uniting the planar members with said web includes means defining a plurality of openings formed in said web and in said planar member and a flexible wire extended through each of said openings.

12. The support of claim 1 wherein said band assumes a collapsible rectangular cross-sectional configuration when said struts are in said second rest position.

13. The support of claim 2 wherein said endless flexible band assumes a collapsible rectangular cross-sectional configuration when said struts are in said second rest position.

14. The support of claim 4 wherein said pair of axially spaced planar members are united with said web by a thin-gauge wire extended therethrough and configured as a running stitch.

15. A collapsible support for supporting a membrane of a dish-shaped configuration, employable as a reflector dish for a high-gain antenna aboard operative space vehicles comprising:

- A. means defining an annular base having a peripheral surface of a cylindrical configuration;
- B. an array of commonly spaced struts of an A-frame configuration, pivotally coupled at their base ends with the peripheral surface of said base and supported for simultaneous pivotal displacement from a first rest position wherein the struts are arranged in a substantially parallel relationship to a second rest position wherein the struts are arranged in a substantially diverging relationship;
- C. an endless flexible band including a pair of axially spaced, planar members of an annular configuration, a web of a cylindrical configuration, wire means configured as running stitches pivotally coupling the web at its opposite ends with said planar members, whereby said band is caused to assume a substantially U-shaped cross-sectional configuration when said struts are in said second rest position;

D. means coupling said endless flexible band with the distal ends of said plurality of struts including a plurality of brackets, each of said brackets being fixed to the distal end of one of said struts and comprising means including a toggle linkage for rigidly supporting the band at diagonally related peripheral portions of said band for supporting said band in a serpentine configuration when the plurality of struts are in said first rest position and for supporting the band in a planar configuration when said struts are in said second rest position;

E. a plurality of rigid gussets interposed in mutually spaced pairs between adjacent distal ends of said

struts and rigidly coupled with said web and said planar members; and

F. a plurality of releasable latches mounted on said band including a bar pivotally coupled at its opposite ends to axially space peripheral portions of said planar members, and a resilient gusset rigidly fixed to one of said planar members, biased into frictional engagement with said bar, and having means defining therefor a locking detent including means defining an opening disposed in a plane common to a selected plane of said bar for receiving the bar therein when said struts are in said second rest position.

16. The support of claim 1 wherein said band further includes a peripheral web of a cylindrical configuration circumscribing the web supported in coaxial relationship with said base.

17. The support of claim 16 further comprising hinge means for pivotally coupling each of said webs with each of said support members for thereby accommodating pivotal displacement between said webs and said support members, whereby said webs and said support members collectively define an annular member having a collapsible, rectangular cross-sectional configuration when said struts are in said second rest position.

18. The support of claim 16 wherein said hinge means includes means defining equally spaced openings within the end portions of each of said webs and in the opposite peripheral portions of each of said support members, and means including a pair of strands of wire extending through adjacent openings for pivotally coupling said webs and said support mem-

bers into an integrated unit.

19. A collapsible support of an annular configuration particularly suited for use in supporting a flexible reflector of a furlable antenna comprising:

- A. a base for said support;
- B. a plurality of mutually spaced struts pivotally coupled at their base ends with said base and supported for simultaneous displacement from a first rest position wherein the struts are arranged in a substantially parallel relationship, to a second rest position wherein the struts are arranged in a substantially diverting relationship; and
- C. an endless flexible band coupled with the distal ends of said plurality of struts including,

1. a first web of cylindrical configuration coaxially related to said base,
2. a second web of a cylindrical configuration circumscribing said first web in a radially spaced relationship therewith,
3. a coaxially related mutually spaced pair of annular support members, and
4. means for pivotally coupling each peripheral portion of each of said support members with an end portion of one of said webs.

20. The support of claim 19 wherein said means for pivotally coupling said supports with said webs includes means defining in adjacent portions of said webs and said planar members an annular array of openings, and means comprising a plurality of wires extended through said openings for pivotally coupling each of said supports with both of said webs.

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